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TECHNICAL REPORT 4070

AN IMPROVED COMPUTER PROGRAM TO CALCULATE THE AVERAGE BLAST IMPULSE LOADS ACTING ON A WALL OF A CUBICLE

STUART LEVY

MAY 1970

PICATINNY ARSENAL
DOVER, NEW JERSEY

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ACKNOWLEDGMENT

This report and computer program were prepared with the advice of Richard Rindner of the Process Engineering Laboratory, Picatinny Arsenal and Norval Dobbs of Ammann and Whitney, Consulting Engineers, New York, who originally developed the program under a project funded by the Armed Forces Explosive Safety Board.

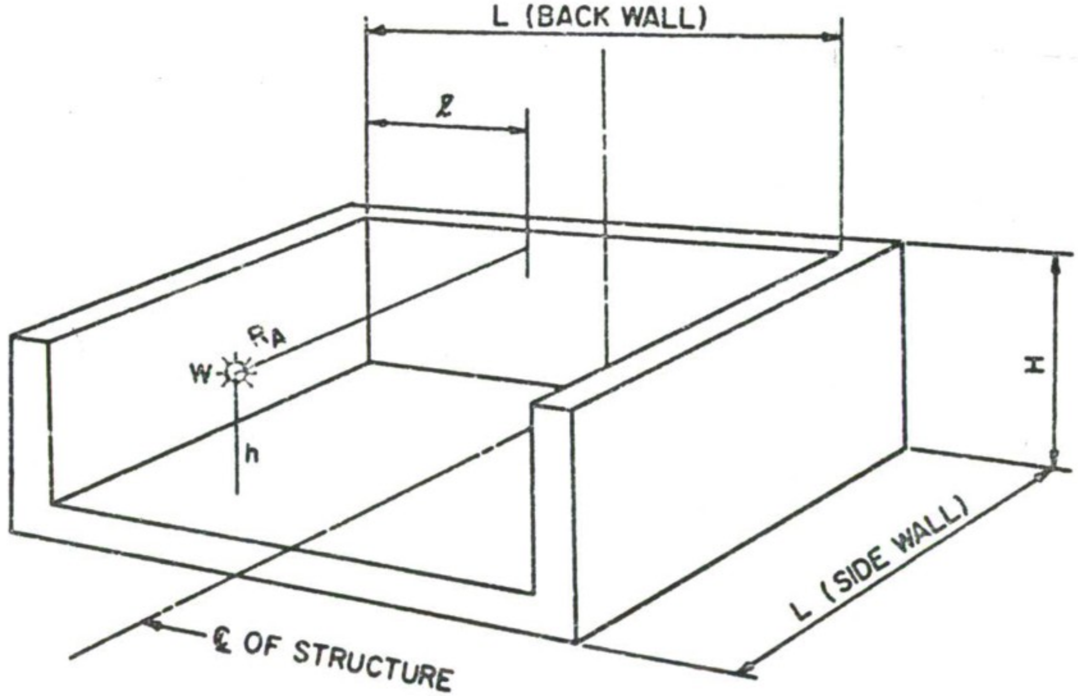


FIGURE 1

CUBICLE PARAMETERS

SUMMARY

An improved computer program was devised to calculate the average blast impulse loads acting on a wall of a cubicle when an explosive charge is detonated within the cubicle. It was formulated by the AED's Process Engineering Laboratory in connection with the Safety Design Criteria Program.

PROGRAM DESCRIPTION

The original computer program was to calculate data points for the construction of impulse charts in regulatory Department of Defense publication Technical Manual 5-1300, "Structures to Prevent the Effects of Accidental Explosion." This original program was prepared by Ammann & Whitney, a consulting engineering firm in New York City, dated June 1969, under contract to Picatinny Arsenal.

The input to the program was simplified. Instead of a possible five data cards per problem only two data cards were required. Two subroutines were added to calculate geometrical ratios and to specify the grid system needed in the problem solution. The output was modified to echo the input and give a clear print-out of the reflected impulse on each wall and the total impulse acting on the wall in question. This program is suitable for use by an engineer with little or no computer background.

The program can be used as a supplement to TM 5-1300. It eliminates the necessity of interpolation or extrapolation from the impulse charts in the manual and can save many hours of tedious hand calculations by completing multiple impulse calculations in a few minutes.

Step-by-step procedures are given for specifying the computer input. Sample input sheets, problem solutions by computer and impulse charts of TM 5-1300 are in Appendix A.

The program prints the solution of each problem on a separate page. The output consists of the title, input data, and the calculated impulse for each reflecting surface and total impulse load.

The computer program is written in Fortran IV and has been run on an IBM 360, Model 65. A copy of the Fortran coding and required input data is in Appendix B.

Limitation

Because of the limitations of the test data used to develop this computer program, extrapolation beyond this range may give inaccurate results. However, to overcome this, the restrictions of the geometrical ratios mentioned on Pages 4-12 of TM 5-1300 are incorporated in the computed program.

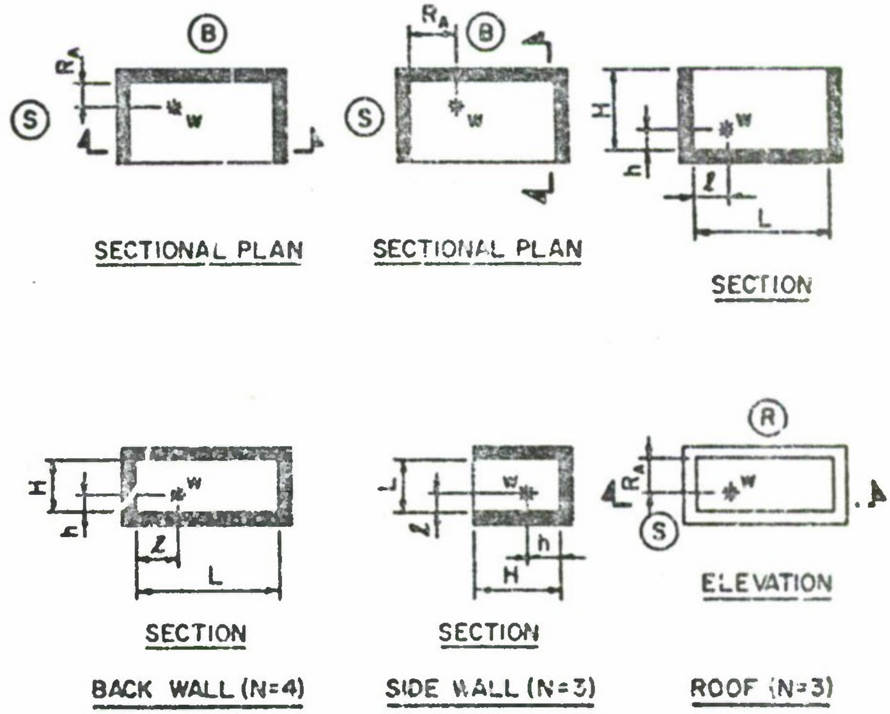


FIGURE 2

THREE WALL CUBICLE WITH ROOF

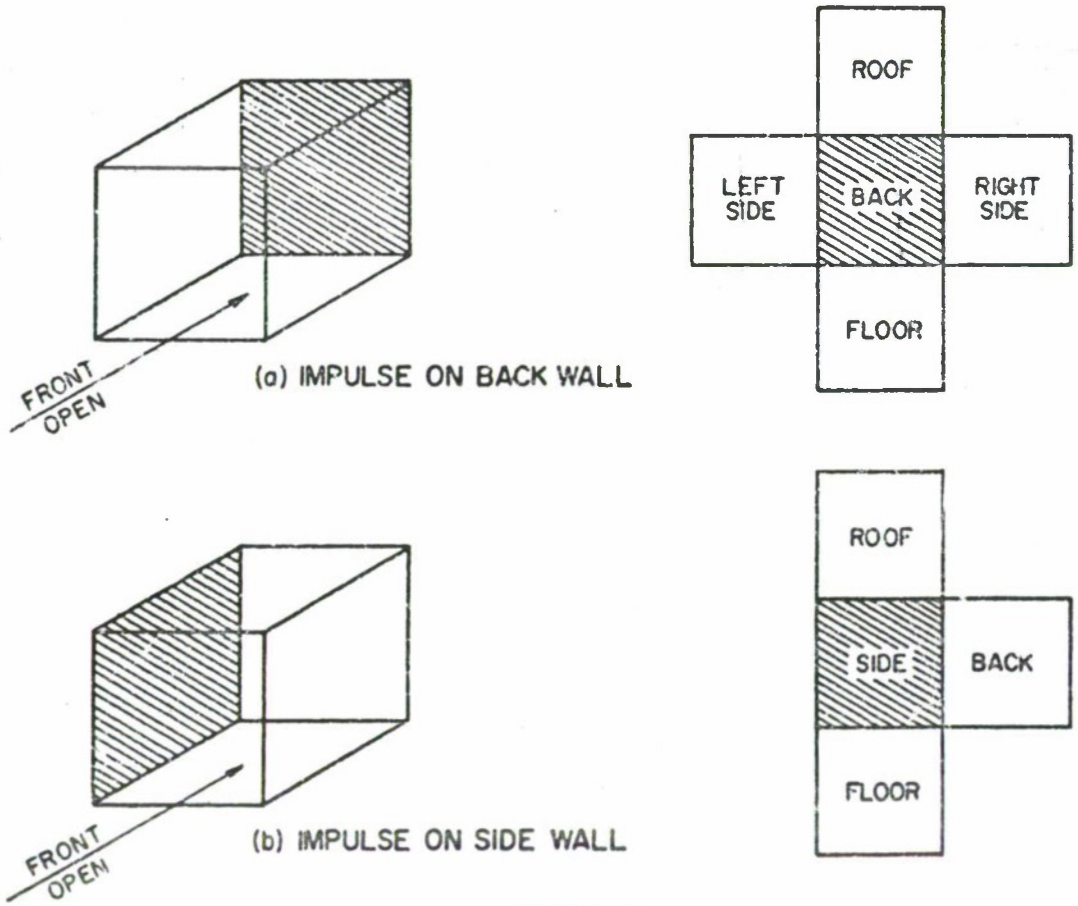


FIGURE 3

REFLECTING SURFACES - 3 WALL CUBICLE WITH ROOF

TABLE 1

INPUT DEFINITIONS AND FIELD SPECIFICATIONS

	Column	Symbol	Description
Card No. 1	1-68		Problem title
Card No. 2	1-10	RA	Distance from center of charge to wall in question (ft.) (Decimal point required.)
Card No. 2	11-20	W	Explosive charge weight (lbs.) (Decimal point required.)
Card No. 2	21-30	H	Height of the wall in question (ft.) (Decimal point required.)
Card No. 2	31-40	L	Length of loaded wall (ft.) (Decimal point required.)
Card No. 2	41-50	h	Height of charge above floor (ft.) (Decimal point required.)
Card No. 2	51-60	l	Minimum distance between the charge to and an adjacent wall (ft.) (Decimal point required.)
Card No. 2	61-70		Leave blank
Card No. 2	71		FLOOR - Insert 1 if present
	72		ROOF - Insert 1 if present
	73		LEFT SIDE - Insert 1 if present
	74		RIGHT SIDE- Insert 1 if present

STEP-BY-STEP PROCEDURE FOR PROGRAM INPUT

To utilize the program, it is necessary to fill out the information required by the two data cards on the input form (Figure 4). The data should be key-punched and inserted in its proper place in the input deck. It should be noted that the required input data in Appendix B must precede this data.

The input parameters are given by the input sheet (Figure 4) and are defined in meaning and card column position in Table 1 and illustrated in Figures 1-3.

TABLE 2

COMPARISON OF COMPUTER RESULTS WITH MANUAL CALCULATIONS

Impulse - PSI - MS

Problem	Manual	Computer	Difference	% Difference
A5	1000	958	42	4.2
A6	8500	8651	151	1.78
A8	117	112	5	4.24

As indicated in Table 2, the difference between the manual and computer calculations is only a few percent. This difference may be accounted for by the smoothing of the impulse curves contained in the manual. The computers results should be more accurate than the manual charts since the calculation are direct and numerical interpolation is used instead of visual.

Appendix A shows the details of the manual and computer calculations.

CARD NO. 1

PROBLEM IDENTIFICATION (TITLE CARD)
1 80

CARD NO. 2

1 10	11 20	21 30	31 40	41 50	51 60	61 70	71	72	73	74
							REFLECTION CODE			
DIST. OF CHARGE FROM WALL	CHARGE WEIGHT	WALL HEIGHT	WALL LENGTH	HEIGHT OF CHARGE ABOVE FLOOR	MIN. DIST. OF CHARGE TO ADJ. WALL		FLOOR	ROOF	LEFT SIDE	RIGHT SIDE
R_A Ft.	W Lbs.	H Ft.	L Ft.	h Ft.	ℓ Ft.					

FIGURE 4

INPUT SHEET

Filling Out the Input Form

These procedures should be followed in filling out the input form.

1. Fill in Title or Problem Identification Card.

2. Sketch the structure and charge location as shown in Figure 1 and 2.

3. Enter RA, W, H, L. h, l. (Units are in feet and ibs; a decimal point must be supplied after each number.)

4. Enter a "1" or "zero" (no decimal point) in the appropriate column of the reflection code of the input sheet. If the reflection surface (floor, roof, left side wall or right side wall) is present enter a 1, otherwise indicate the absence of the surface by a zero. Sketching the cubicle and unfolding the view (Figure 3) will help determine the reflecting surface. Detailed instructions follow.

Specifying Reflection Code

In performing its calculations, the program considers the effect of reflection of the original blast impulse from surfaces at right angles and in contact with the wall whose impulse load is being computed. Figure 3 illustrates a method for determining the reflecting surfaces of a three-wall cubicle with roof. Figure 3(a) shows how to specify the reflection code on the input sheet (Figure 4) when it is desired to calculate the impulse load on the back wall. By unfolding the walls of the cubicle, keeping the back wall in the center, it is noted that there are four reflecting surfaces at right angles and in contact with the back wall: the floor, roof and two side walls. There the presence of these reflecting surfaces are indicated on the input sheet by putting a 1 in each of the columns labeled Floor, Roof, Left Side, Right Side. The reflection code of Figure 4 would be 1111. Sample Problem A6 (Appendix A) has the same configuration of Figure 4 except that it lacks a roof; its reflection code is 1011.

Sometimes the wall in question is not the back wall. In order to use the input form, the cubicle should be rotated so that the wall occupies the same position as the back wall. The solution will be the same as a back wall problem.

In Sample Problem A8, (Appendix A) it is required to calculate the impulse load on the roof of a cubicle. The cubicle is rotated 90° so that the roof becomes the back wall, the floor the front wall, and the front wall the roof. This configuration will then be the same as Figure 3(a). The input sheet should then be filled out accordingly.

Figure 3(b) shows an unfolded view of the same cubicle used as an aid in calculating the impulse on a side wall. The three reflecting surfaces are the roof, back wall and floor. In specifying the input code, the cubicle is rotated 90° so that the side wall is treated as a back wall and vice versa. The reflection code of Figure 4 (input sheet) would be 1110. Sample Problem A5 (Appendix A) shows the calculation of the impulse loading on a side wall of a cubicle similar to Figure 4 except that Sample Problem A5 lacks a roof; its reflection code is 1010.

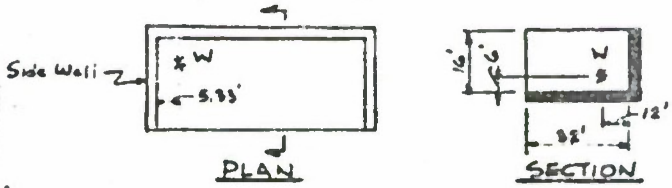
APPENDICES

APPENDIX A

Sample Problems

Example A-5 CLOSE-IN BLAST LOADS

Required: Average scaled impulse on the side wall of a three wall cubicle from an explosive charge of 245#. The cubicle is fully vented.



Solution:

Step 1 - $H = 16$ ft. $L = 32$ ft. $W = 245$ lbs. For definition of terms see Fig. 4-15 - Side wall of three wall cubicle ($N = 2$)

$h = 6$ ft. $l = 12$ ft. $R_A = 5.33$ ft.

Step 2 - $\frac{h}{H} = 0.375$ $\frac{l}{L} = 0.375$ $\frac{L}{R_A} = 6.00$ $\frac{L}{H} = 2.00$

$$Z_A = \frac{R_A}{W^{1/3}} = \frac{5.33}{(245)^{1/3}} = 0.85 \text{ ft/lb}^{1/3}$$

Interpolation is required for Z_A, $\frac{L}{H}$, $\frac{l}{L}$ & $\frac{h}{H}$.

Step 3 - Determine & tabulate the values of $\bar{i}_b$ from Figures 4-28 thru 4-42 (see Table 4-16 for $N = 2$) for: $L/R_A = 6.00$, $Z_A = 0.85$ (interpolate by inspection) and for values given for L/H, l/L and h/H. See Table A-1.

Step 4-a. Plot $\bar{i}_b$ versus $\frac{L}{H}$ for the values of l/L and constant h/H. Figure A-3

b. Determine $\bar{i}_b$ for $\frac{L}{H} = 2.00$, $\frac{h}{H} = 0.25$ & various $\frac{l}{L}$ ratios by entering Figure A-3a with $\frac{L}{H} = 2.00$

$\frac{l}{L}$	$\bar{i}_b$
0.10	240
0.25	210
0.50	190
0.75	170

c. Repeat above step for $\frac{h}{H} = 0.33, 0.50$ & 0.75 by entering Figures A-3b thru A-3d with $\frac{L}{H} = 2.00$. Tabulate results

TABLE A-1

TABULATION OF $\bar{i}_b$ FOR $L/R_A=6, Z_A=0.85$ AND VARIOUS L/H, ℓ/L AND h/H RATIOS

h/H	0.15				0.25				0.50				0.75		
ℓ/L / L/H	.10	.25	.50	.75	.10	.25	.50	.75	.10	.25	.50	.75	.25	.50	.75
0.75	135	125	105	95	135	110	90	72	130	90	75	65	77	67	58
1.50	210	183	165	150	205	165	140	125	180	130	108	95	115	95	80
3.00	230	255	225	200	270	240	225	200	260	200	170	145	170	145	130
6.00	310	280	245	225	320	285	265	245	310	280	250	230	260	250	230
Figure	4-28	4-29	4-30	4-31	4-32	4-33	4-34	4-35	4-36	4-37	4-38	4-39	4-40	4-41	4-42

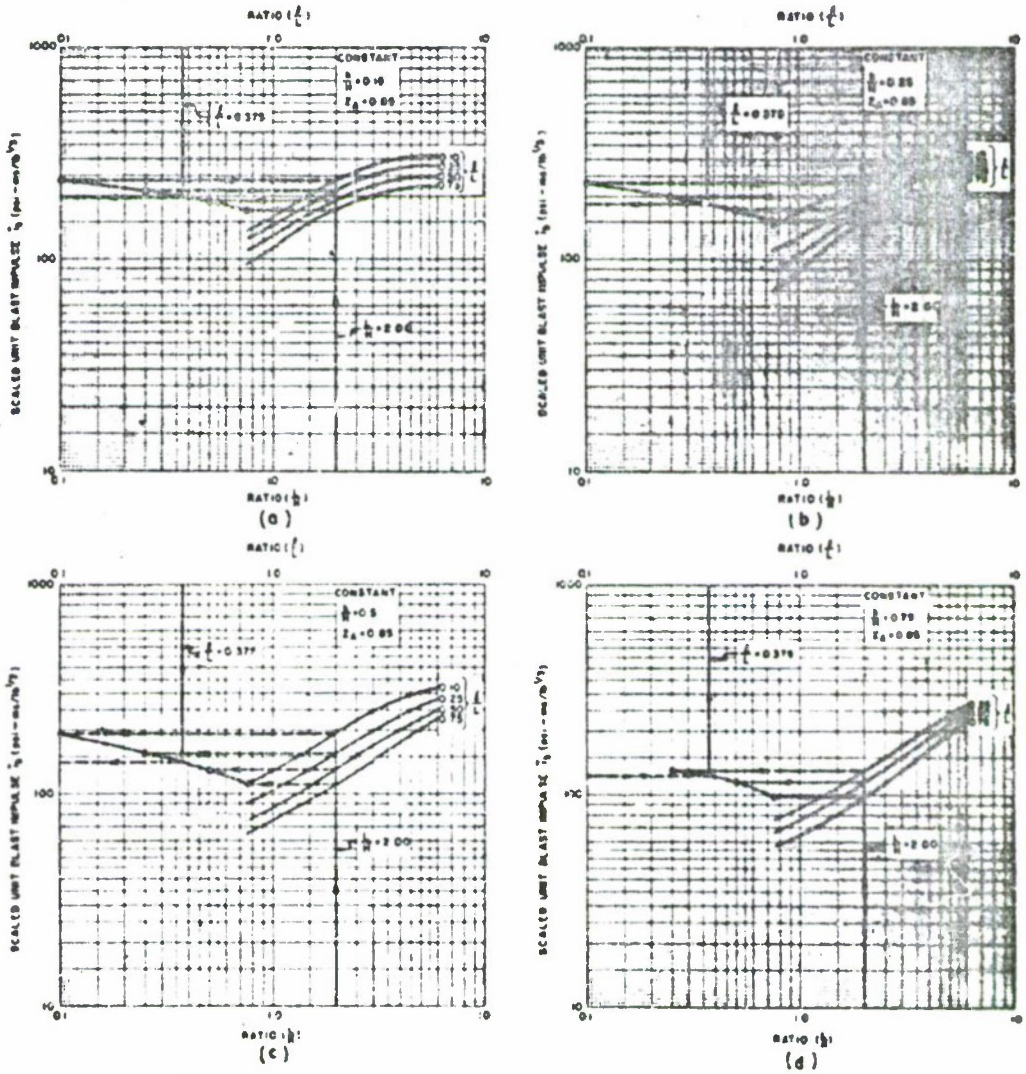


FIG. A-3 INTERPOLATION OF SCALED IMPULSE FOR L/H and ℓ/L RATIOS

d. On each h/H chart, plot $\bar{i}_b$ (Steps 4b & 4c) versus ℓ/L (upper abscissa of Figures A-3a thru A-3d)

e. Determine $\bar{i}_b$ for $\frac{\ell}{L} = 0.375$ on each h/H chart by entering Figures A-3a thru A-3d with $\frac{\ell}{L} = 0.375$ & reading curves plotted in Step 4d.

$\frac{h}{H}$	$\bar{I}_b$	
0.15	137	Figure A-3a
0.25	185	Figure A-3b
0.50	140	Figure A-3c
0.75	123	Figure A-3d

f. Plot $\bar{i}_b$ (Step 4e) versus $\frac{h}{H}$. Figure A-4

Step 5 - For $\frac{h}{H} = 0.375$ read $\bar{i}_b = 160$ psi-ms/lb$^{1/3}$ on Figure A-4.

$$i_b = 160(245)^{1/3} = 1000 \text{ psi-ms}$$

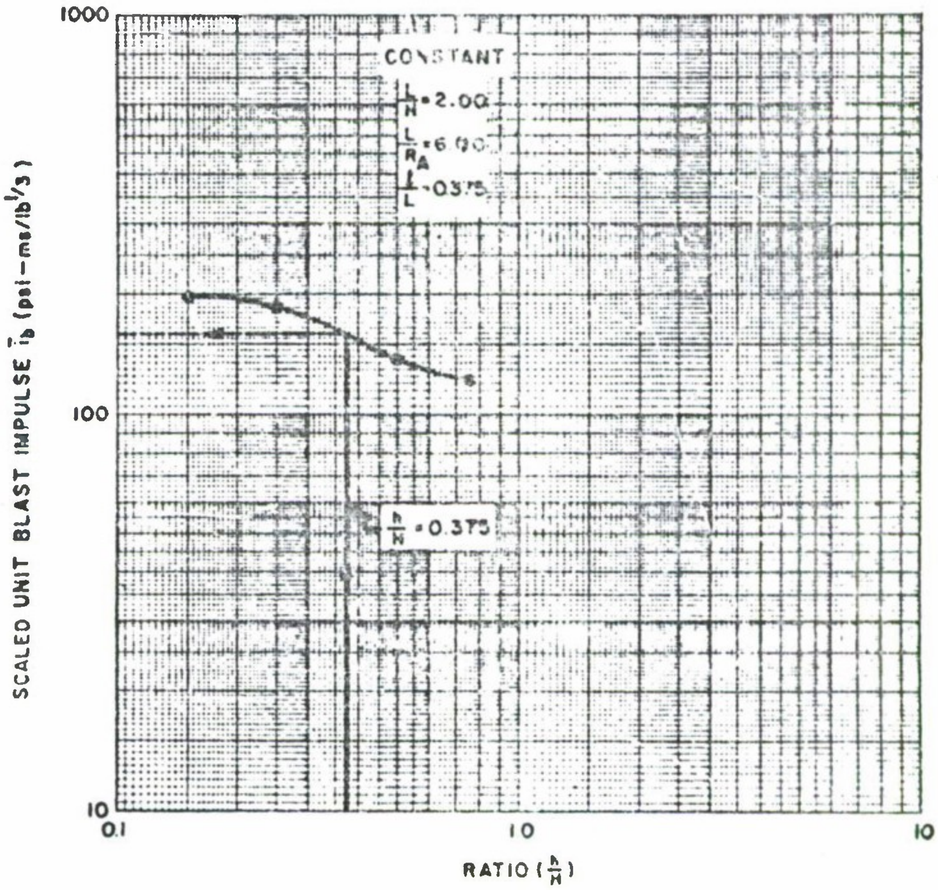


FIG. A-4 INTERPOLATION OF SCALED IMPULSE FOR h/H RATIOS

CARD NO. 1

PROBLEM IDENTIFICATION (TITLE CARD)	
1 PROBLEM A5	80

CARD NO. 2

1 10	11 20	21 30	31 40	41 50	51 60	61 70	71	72	73	74
							REFLECTION CODE			
DIST. OF CHARGE FROM WALL	CHARGE WEIGHT	WALL HEIGHT	WALL LENGTH	HEIGHT OF CHARGE ABOVE FLOOR	MIN. DIST. OF CHARGE TO ADJ. WALL		FLOOR	ROOF	LEFT SIDE	RIGHT SIDE
R_A Ft.	W Lbs.	H Ft.	L Ft.	h Ft.	ℓ Ft.					
5.33	245.	16.	32.	6.	12.		1	0	1	0

FIGURE 4

INPUT SHEET

PROBLEM A5

INPUT

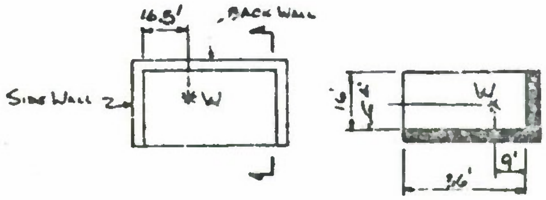
DISTANCE OF CHARGE FROM BLAST WALL	FT.	5.32
CHARGE WEIGHT	LBS.	245.00
BLAST WALL HEIGHT	FT.	16.00
BLAST WALL LENGTH	FT.	32.00
HEIGHT OF CHARGE ABOVE GROUND	FT.	6.00
MIN. DIST. BETWEEN CHARGE & ADJ. WALL	FT.	12.00
REFLECTION CODE		1 0 1 0

OUTPUT

REFLECTING SURFACE	IMPULSE PSI-MS
FLOOR	631.75
LEFT SIDE WALL	326.40
TOTAL	958.15

Example A-6 CLOSE-IN BLAST LOADS

Required: Average scaled impulse on the back wall of a three wall cubicle from an explosive charge of 4500#. The cubicle is fully vented.



PLAN

Solution:

Step 1 - $H = 16$ ft. $\quad L = 36$ ft. $\quad W = 4500$ lbs. $\quad$ For definition of terms see Fig. 4-15

$h = 4$ ft. $\quad \ell = 9$ ft. $\quad R_A = 16.5$ ft. $\quad$ Back wall of three wall cubicle (N=3)

Step 2 - $\frac{h}{H} = 0.25 \quad \frac{\ell}{L} = 0.25 \quad \frac{L}{R_A} = 2.18 \quad \frac{L}{H} = 2.25$

$$Z_A = \frac{R_A}{W^{1/3}} = \frac{16.5}{(4500)^{1/3}} = 1.00 \text{ ft/lb}^{1/3}$$

Interpolation is required for $\frac{L}{H}$

Step 3 - Determine the values of $\bar{i}_b$ from Figure 4-47 (determined from Fig. 4-16 for N=3, $h/H = 0.25$, $\ell/L = 0.25$) for $\frac{L}{H}$ ratios of 0.75, 1.50, 3.00 & 6.00.

$\frac{L}{H}$	$\bar{i}_b$
0.75	365
1.50	480
3.00	530
6.00	570

Step 4 - Plot $\bar{i}_b$ versus $\frac{L}{H}$ $\qquad$ Figure A-5

Step 5 - For $\frac{L}{H} = 2.25$ read $\bar{i}_b = 515$ psi-ms/lb$^{1/3}$ on Figure A-5.

$$i_b = 515(4500)^{1/3} = 8500 \text{ psi-ms}$$

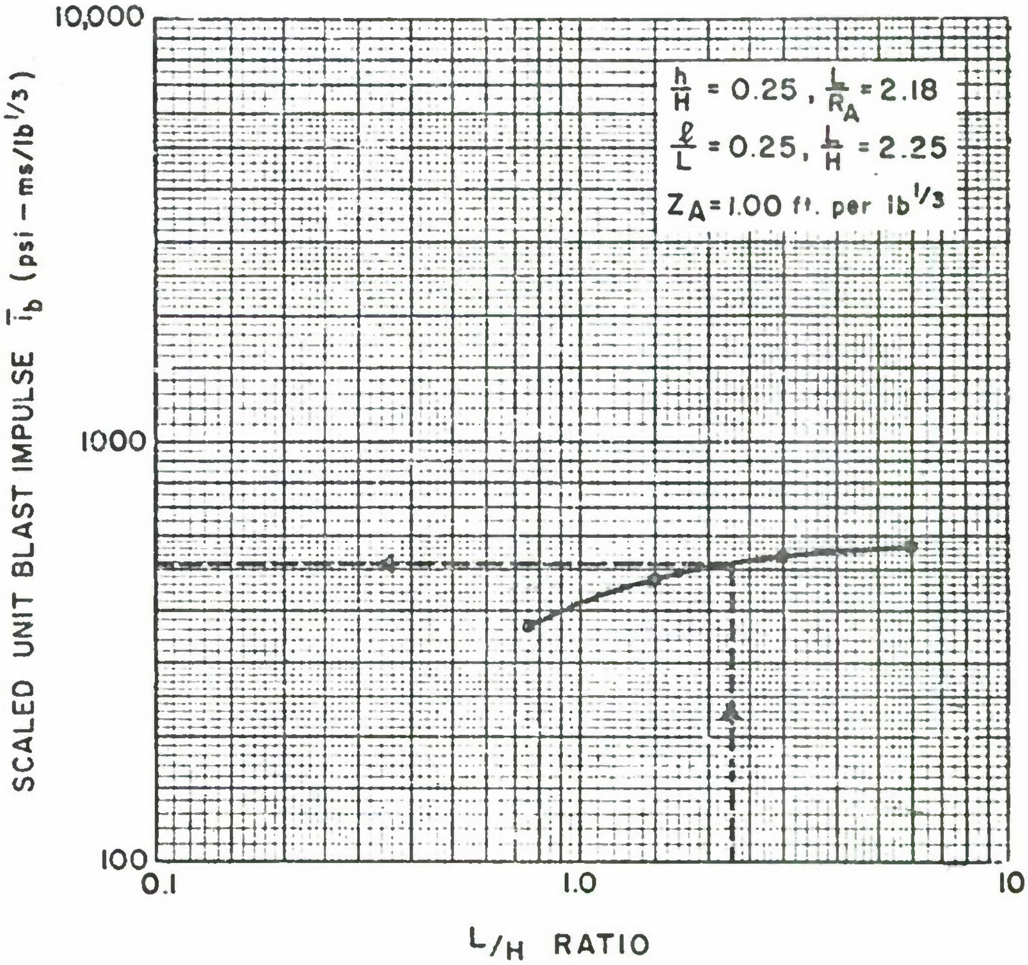


FIG. A-5 INTERPOLATION OF SCALED IMPULSE FOR $\frac{L}{H}$ RATIOS

CARD NO. 1

PROBLEM IDENTIFICATION (TITLE CARD)	
1 PROBLEM A6	80

CARD NO. 2

1 10	11 20	21 30	31 40	41 50	51 60	61 70	71	72	73	74
DIST. OF CHARGE FROM WALL	CHARGE WEIGHT	WALL HEIGHT	WALL LENGTH	HEIGHT OF CHARGE ABOVE FLOOR	MIN. DIST. OF CHARGE TO ADJ. WALL		REFLECTION CODE			
							FLOOR	ROOF	LEFT SIDE	RIGHT SIDE
R_A Ft.	W Lbs.	H Ft.	L Ft.	h Ft.	ℓ Ft.					
16.5	4500.	16.	36.	4.	9.		1	0	1	1

FIGURE 4

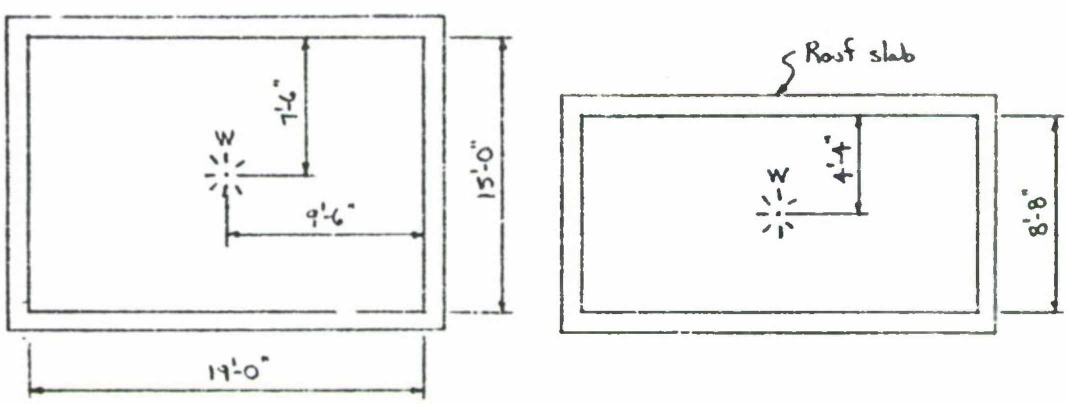
INPUT SHEET

PROBLEM A6

	INPUT	
DISTANCE OF CHARGE FROM BLAST WALL	FT.	16.50
CHARGE WEIGHT	LBS.	4500.00
BLAST WALL HEIGHT	FT.	16.00
BLAST WALL LENGTH	FT.	36.00
HEIGHT OF CHARGE ABOVE GROUND	FT.	4.00
MIN. DIST. BETWEEN CHARGE & ADJ. WALL	FT.	9.00
REFLECTION CODE		1 0 1 1
	OUTPUT	
REFLECTING SURFACE	IMPULSE PSI-MS	
FLOOR	4340.05	
LEFT SIDE WALL	2744.60	
RIGHT SIDE WALL	1566.15	
TOTAL	8650.79	

Example A-8 CLOSE-IN BLAST LOADS

Required: Average scaled impulse and maximum mean pressure on the roof slab of an enclosed cubicle with a small venting area from an explosive charge of 3#. The cubicle dimensions are as shown below.



Plan

Elevation

Fig A-7

Solution

Step 1 - $H = 15$ ft. $L = 19$ ft $W = 3^{\#}$
$h = 7.5$ ft $\ell = 9.5$ ft $R_A = 4.33$ ft.

For definition of terms see Figure 4-15 - Four wall cubicle with roof (N=4)

Step 2 - $\frac{h}{H} = 0.50$ $\frac{\ell}{L} = 0.50$ $\frac{L}{R_A} = 4.39$ $\frac{L}{H} = 1.27$

$$Z_A = \frac{R_A}{W^{1/3}} = \frac{4.33}{(3)^{1/3}} = 3.00 \text{ ft/lb}^{1/3}$$

Interpolation is required for $\frac{L}{H}$.

Step 3 - Determine the value of $\bar{I}_b$ from Figure 4-62 (From Figure [illegible] for N=4, $h/H = 0.50$ & $\ell/L = 0.50$) for $\frac{L}{H}$ ratios of 0.75, 1.50, 3.00 and 6.00.

Problem A-6 CLOSE-IN BLAST LOADS

Problem: Determine the average scaled impulse and maximum mean pressure on the wall of an enclosed cubicle from a contained, partially vented explosion.

Procedure:

Step 1 - Select from Figure 4-15 the structural configuration which will define the number (N) and location of effective reflecting surfaces for the wall of the structure in question. Determine the charge weight W, and as defined by the structural configuration chosen above, the charge location parameters (R_A, h, ℓ) and the structural parameters (L, H).

Step 2 - Calculate chart parameters $\frac{h}{H}$, $\frac{\ell}{L}$, $\frac{L}{R_A}$, $\frac{L}{H}$ and scaled distance Z_A.

$$Z_A = \frac{R_A}{W^{1/3}}$$

Steps 3,4 & 5 - Following the procedure outlined in Problem 5, determine $\bar{i}_b$ conforming to the above parameters.

Step 6 - Calculate charge-volume ratio $\left(\frac{W}{V}\right)$

Step 7 - For calculated $\frac{W}{V}$, read p_{mo} from Figure 4-65

$\frac{L}{H}$	I_b
0.75	74
1.50	87
3.00	112
6.00	171

Step 4 - Plot I_b versus $\frac{L}{H}$. Figure A-8

Step 5 - For $\frac{L}{H} = 1.27$ read $I_b = 81$ psi-ms/lb$^{1/3}$ on Figure A-8

$I_b = 81(3)^{1/3} = 117$ psi-ms

Step 6 - Calculate charge-volume ratio $\left(\frac{W}{V}\right)$

$$\frac{W}{V} = \frac{3}{19(15)8.67} = 0.00121 \text{ lb/ft}^3$$

Step 7 - For $\frac{W}{V} = 0.00121$ lb/ft^3 read $p_{mo} = 19$ psi on Figure 4-65

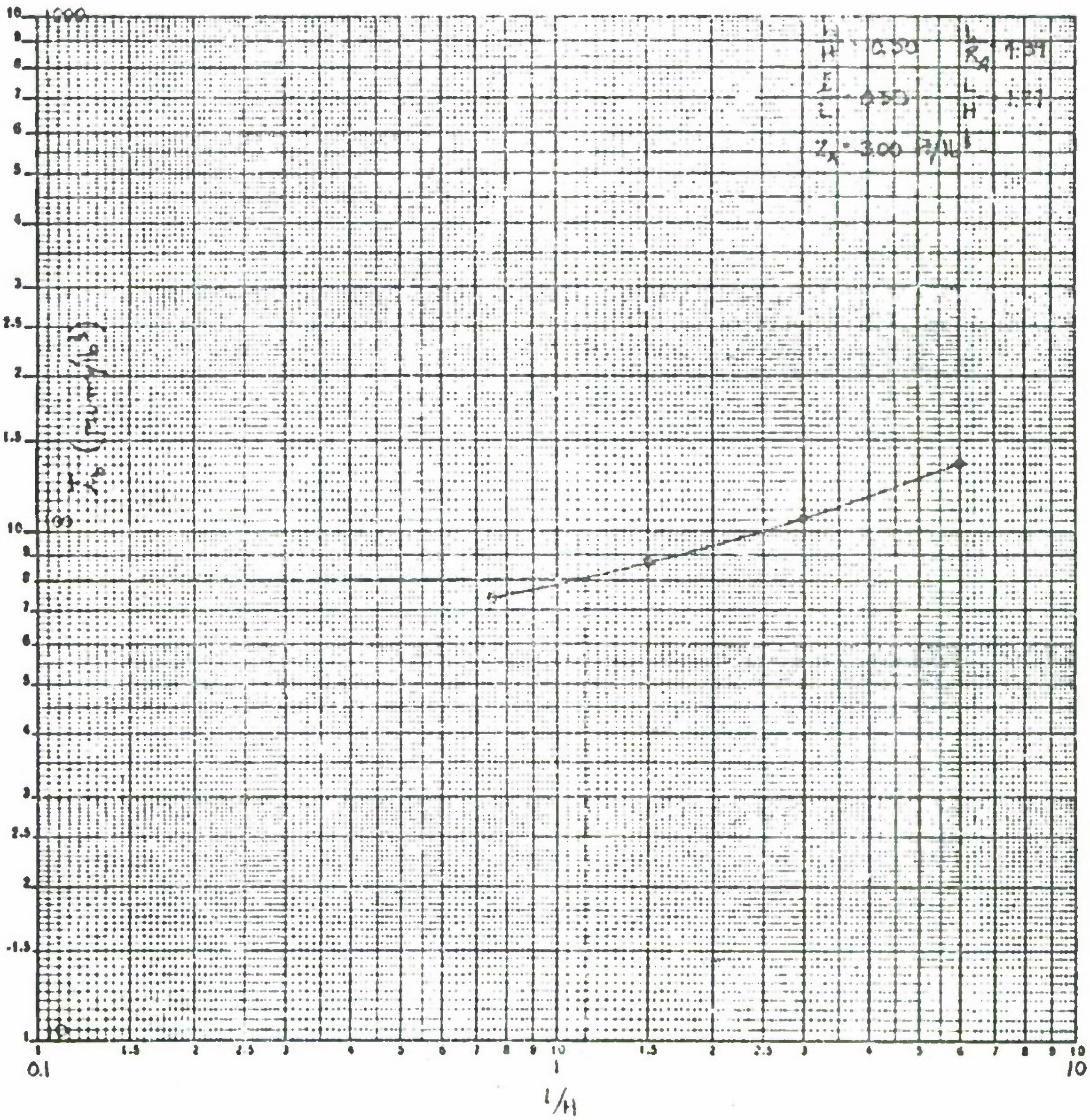


Fig. A-8 Interpolation of Scale Impulse for $\frac{L}{H}$ Ratios

CARD NO. 1

PROBLEM IDENTIFICATION (TITLE CARD)
1 PROBLEM A8 80

CARD NO. 2

1 10	11 20	21 30	31 40	41 50	51 60	61 70	71	72	73	74
							REFLECTION CODE			
DIST. OF CHARGE FROM WALL	CHARGE WEIGHT	WALL HEIGHT	WALL LENGTH	HEIGHT OF CHARGE ABOVE FLOOR	MIN. DIST. OF CHARGE TO ADJ. WALL		FLOOR	ROOF	LEFT SIDE	RIGHT SIDE
R_A Ft.	W Lbs.	H Ft.	L Ft.	h Ft.	ℓ Ft.					
4.33	3.	15.	19.	7.5	9.5		1	1	1	1

FIGURE 4

INPUT SHEET

PROBLEM A8

INPUT

DISTANCE OF CHARGE FROM BLAST WALL	FT.	4.33
CHARGE WEIGHT	LBS.	3.00
BLAST WALL HEIGHT	FT.	15.00
BLAST WALL LENGTH	FT.	19.00
HEIGHT OF CHARGE ABOVE GROUND	FT.	7.50
MIN. DIST. BETWEEN CHARGE & ADJ. WALL	FT.	9.50
REFLECTION CODE		1 1 1 1

OUTPUT

REFLECTING SURFACE	IMPULSE PSI-MS
FLOOR	29.93
ROOF	29.93
LEFT SIDE WALL	26.09
RIGHT SIDE WALL	26.09
TOTAL	112.03

APPENDIX B

Fortran Coding, Compilation
and
Required Input Data

```
FORTRAN IV G LEVEL  1, MOD 2                MAIN               DATE = 69342          15/42/41                PAGE 0001

                   CPICATN                                                                                PICA0010
                   C       PICATINNY STUDIES FOR REFLECTING IMPULSE                                      PICA0020
      0001                 DIMENSION P2(16,16),PH(16,16),PA(18,5),PCR(18,6),PSDZ(16),PSD(16),PICA0030
                          1PRZ(16),PR(15),PIPZ(16),PIR(16),ZN(30),ALPLAN(30),      HCON(12),PHPICA0040
                          2SAR(30),RHOAH(30),ZPLAN(30,30),APRAL(30,1),AZZ(30,1),APIIR(30,1), PICA0050
                          3ZPS(30,30),          ANG2(30,30),ANG1(30,30),PCON(17),PAA(30),PFCR)PICA0060
                          430),CRAL(30,30),ZSPLAN(30,30),DCEL(30,30),PRAL(30,30),               PICA0070
                          5     ZZ(30,30),ANS(4),   PIIR(30,30),SIMP(30,30),SUM(30),SIMPAV(30)PICA0080
                          6,SV(30),SPIIR(30),SPI(30),FINAV(30),ZTN(12)                         PICA0090
      0002                 DIMENSION ICODE(4),HDG(17)
      0003                 ZTN(1)=0.35                                                            PICA0240
      0004                 ZTN(2)=0.435                                                           PICA0250
      0005                 ZTN(3)=0.6                                                             PICA0260
      0006                 ZTN(4)=0.69                                                            PICA0270
      0007                 ZTN(5)=0.77                                                            PICA0280
      0008                 ZTN(6)=0.91                                                            PICA0290
      0009                 ZTN(7)=1.1                                                             PICA0300
      0010                 ZTN(8)=1.48                                                            PICA0310
      0011                 ZTN(9)=1.7                                                             PICA0320
      0012                 ZTN(10)=2.7                                                            PICA0330
      0013                 ZTN(11)=5.1                                                            PICA0340
      0014                 ZTN(12)=7.3                                                            PICA0350
      0015                 HCON(1)=0.0625                                                         PICA0360
      0016                 HCON(2)=0.125                                                          PICA0370
      0017                 HCON(3)=0.25                                                           PICA0380
      0018                 HCON(4)=0.375                                                          PICA0390
      0019                 HCON(5)=0.5                                                            PICA0400
      0020                 HCON(6)=0.75                                                           PICA0410
      0021                 HCON(7)=1.0                                                            PICA0420
      0022                 HCON(8)=1.5                                                            PICA0430
      0023                 HCON(9)=2.0                                                            PICA0440
      0024                 HCON(10)=3.0                                                           PICA0450
      0025                 HCON(11)=4.0                                                           PICA0460
      0026                 HCON(12)=5.0                                                           PICA0470
      0027                 PCON(1)=3.7                                                            PICA0480
      0028                 PCON(2)=9.8                                                            PICA0490
      0029                 PCON(3)=22.1                                                           PICA0500
      0030                 PCON(4)=58.8                                                           PICA0510
      0031                 PCON(5)=132.0                                                          PICA0520
      0032                 PCON(6)=200.0                                                          PICA0530
      0033                 PCON(7)=300.0                                                          PICA0540
      0034                 PCON(8)=400.0                                                          PICA0550
      0035                 PCON(9)=500.0                                                          PICA0560
      0036                 PCON(10)=700.0                                                         PICA0570
      0037                 PCON(11)=1000.0                                                        PICA0580
      0038                 PCON(12)=1500.0                                                        PICA0590
      0039                 PCON(13)=2000.0                                                        PICA0600
      0040                 PCON(14)=3000.0                                                        PICA0610
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0041              PCON(15)=6000.0                                              PICA0620
0042              PCON(16)=5000.0                                              PICA0630
0043              PCON(17)=7000.0                                              PICA0640
0044              NWALL =4
0045              READ  ( 5    ,903)N1 ,((PZ(I,J),PH(I,J),J=1,N1),I=1,12)     PI
0046              READ  ( 5    ,903)N2 ,((PA(I,J),PCR(I,J),J=1,N2),I=1,18)    PICA0660
0047              READ  ( 5    ,903)N4 ,(PSCZ(I),PSC(I),I=1,N4)               PICA0670
0048              READ  ( 5    ,903)N5 ,(PRZ(I),PR(I),I=1,N5)                 PICA0680
0049              READ  ( 5    ,903)N6 ,(PIRZ(I),PIR(I),I=1,N6)               PICA0690
0050          1   READ(5,901)(HDG(I),I=1,17)
0051        901   FORMAT(17A4)
0052              WRITE (6      ,802)                                          PICA0750
0053              WRITE(6,804)(HDG(I),I=1,17)
0054        804   FORMAT(1X,17A4)
0055              READ(5,917)R,W,H,EL,HLIT,ELLIT,(ICODE(I),I=1,4)
0056        917   FORMAT(6F10.0,10X,4I1)
0057              WRITE(6,924)R,W,H
0058        924   FORMAT(     ///50X,5HINPUT,///,10X,
                 1 45HDISTANCE OF CHARGE FROM BLAST WALL         FT.,10X,F10.2//10X,
                 2 45HCHARGE WEIGHT                              LBS.,10X,F10.2,//10X,
                 3 45HBLAST WALL HEIGHT                          FT.,10X,F10.2)
0059              WRITE(6,925)EL,HLIT,ELLIT,(ICODE(I),I=1,4)
0060        925   FORMAT(/10X,
                 1 45HBLAST WALL LENGTH                          FT.,10X,F10.2,//10X,
                 2 45HHEIGHT OF CHARGE ABOVE GROUND              FT.,10X,F10.2,//10X,
                 3 45HMIN. DIST. BETWEEN CHARGE & ADJ. WALL      FT.,10X,F10.2,//10X,
                 4 45HREFLECTION CODE                            ,8X,4(2X,I1))
0061              WRITE(6,926)
0062        926   FORMAT(////50X,6HOUTPUT///10X,20HREFLECTING SURFACE
                 1 25X, 15HIMPULSE PSI-MS ///)
0063              NC=1                                                         PICA0790
0064              TOTAL=0.0                                                    PICA0800
0065          2   CONTINUE
0066              ZA=R/W**0.333333
0067              CALL RATIO(R,EL,ELLIT,H,HLIT,ZBZA,RLL,HH,RLH)
0068              IF(NC.EQ.2.OR.NC.EQ.4)GO TO 923
0069              CALL GRID(H,HLIT,NSPH,NDULP)
0070              CALL GRID(EL,ELLIT,NSPL,NLTOL)
0071              IF(NSPH.LT.4)NSPH=4
0072              IF(NSPL.LT.4)NSPL=4
0073        923   CONTINUE
0074              NLI=NSPL+1-NLTOL
0075              ZB=ZBZA*ZA                                                   PICA0880
0076              HHH=2.C*ZB/RLH                                               PICA0890
0077              HBAR=HH*2.0*ZB/RLH                                           PICA0900
0078              IF(HBAR-0.0625)4,5,5                                         PICA0910
0079          4   WRITE (6      ,912)
0080              GO TO 8                                                      PICA0930
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0081          5 IF(HBAR-15.0)6,6,7                                          PICA0950
0082          7 WRITE (6     ,916)
0083            GO TO 8                                                     PICA0960
0084          6 SPL=NSPL                                                    PICA0970
0085            SPH=NSPH                                                    PICA0980
0086            SMA=2.0*ZB/SPL                                              PICA0990
0087            SMB=2.0*ZB/(RLH*SPH)                                        PICA1000
0088            DO 3 I=1,NLI                                                PICA1010
0089            A=I                                                         PICA1020
0090            ZN(I)=SQRT(ZA**2+((A-1.0)*SMA)**2)                          PICA1030
0091            DO 1000 J=1,12                                              PICA1040
0092            IF(HBAR-HCON(J))1001,1001,1002                              PICA1050
0093       1001 IF(ZN(I)-ZTN(J))1003,1005,1005                              PICA1060
0094       1003 ZMM=ZN(I)                                                   PICA1070
0095            CALL HHA(HBAR,PZ(1,1),PH(1,1),ZMM,PHBAR1,N1,NLI,HCON(1))    PICA1080
0096            IF(PHBAR1-0.01)1006,1006,1007                               PICA1090
0097       1007 PHBAR1=0.01                                                 PICA1100
0098            GO TO 1006                                                  PICA1110
0099       1002 IF(HBAR-5.0)1000,1000,1004                                  PICA1120
0100       1004 ZMM=7.3                                                     PICA1130
0101            GO TO 1008                                                  PICA1140
0102       1000 CONTINUE                                                    PICA1150
0103       1005 ZMM=ZN(I)                                                   PICA1160
0104       1008 CALL HHA(HBAR,PZ(1,1),PH(1,1),ZMM,PHBAR1,N1,NLI,HCON(1))    PICA1170
0105       1006 IF(PHBAR1-HHH)3,3,9                                         PICA1180
0106          9 PHBAR1=HHH                                                  PICA1190
0107          3 PHBAR(I)=PHBAR1                                             PICA1200
0108         47 DO 46 I=1,NLI                                               PICA1210
0109         46 RHBAH(I)=PHBAR(I)*RLH/(2.0*ZB)                              PICA1220
C               FIND ZPLAN                                                  PICA1230
0110            NNN=2                                                       PICA1240
0111            NN=NSPH+1                                                   PICA1250
0112            DO 63 I=1,NLI                                               PICA1260
0113            ZPLAN(I,1)=SQRT(ZN(I)**2+HBAR**2)                           PICA1270
0114            DO 48 J=2,NN                                                PICA1280
0115            B=J-1                                                       PICA1290
0116            ZOOPL=SQRT(ZN(I)**2+(HBAR+B*SMB)**2)                        PICA1300
0117            TESTD=0.02*ZOOPL                                            PICA1310
0118            DO 2000 K=1,12                                              PICA1320
0119            IF(HHAN-HCON(K))2001,2001,2002                              PICA1330
0120       2001 IF(ZN(I)-ZTN(K))2003,2005,2005                              PICA1340
0121       2003 ZPLAN(I,J)=ZOOPL                                            PICA1350
0122            GO TO 48                                                    PICA1360
0123       2002 IF(HBAR-5.0)2000,2000,2004                                  PICA1370
0124       2004 IF(ZN(I)-7.3)2003,2005,2005                                 PICA1380
0125       2000 CONTINUE                                                    PICA1390
0126       2005 ZM=ZN(I)                                                    PICA1400
0127         61 CALL HHA(HBAR,PZ(1,1),PH(1,1),ZM,PHBAR1,N1,NLI,HCON(1))     PICA1410
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0128            HOL=PHBAR1-B*SMB                                                        PICA1420
0129            IF(HOL)208,209,209                                                      PICA1430
0130        209 ZPLAN(I,J)=SQRT(ZM**2+HBAR**2)                                          PICA1440
0131            GO TO 49                                                                PICA1450
0132        208 ZSTART=SQRT(ZDOPL**2-HBAR**2)                                           PICA1460
0133         62 CALL HBAR(HBAR,PZ(1,1),PHI(1,1),ZSTART,PHBAR1,N1,NL1,MCON(1))           PICA1470
0134            IF(PHBAR1-2.0)211,211,212                                               PICA1480
0135        212 BSMB=B*SMB                                                              PICA1490
0136            IF(PHBAR1-BSMB)220,221,221                                              PICA1500
0137        220 PHBAR1=2.0                                                              PICA1510
0138            GO TO 222                                                               PICA1520
0139        221 PHBAR1=BSMB                                                             PICA1530
0140        222 ZM=SQRT(ZDOPL**2-(HBAR*PHBAR1)**2)                                      PICA1540
0141            GO TO 209                                                               PICA1550
0142        211 ZNEW=SQRT(ZSTART**2+(PHBAR1*HBAR)**2)                                   PICA1560
0143            IF(ZDOPL-ZNEW)58,59,60                                                  PICA1570
0144         58 ZDIT=ZNEW-ZDOPL                                                         PICA1580
0145            IF(ZDIT-TEST)59,59,200                                                  PICA1590
0146        200 ZSTART=0.999*ZSTART                                                     PICA1600
0147            GO TO 62                                                                PICA1610
0148         59 ZM=ZSTART                                                               PICA1620
0149            GO TO 209                                                               PICA1630
0150         60 ZDIT=ZDOPL-ZNEW                                                         PICA1640
0151            IF(ZDIT-TEST)59,59,210                                                  PICA1650
0152        210 ZSTART=1.0003*ZSTART                                                    PICA1660
0153            GO TO 62                                                                PICA1670
0154         49 CONTINUE                                                                PICA1680
0155         63 CONTINUE                                                                PICA1690
0156            DO 65 I=1,NLI                                                           PICA1700
0157            DO 64 J=1,NN                                                            PICA1710
0158            ZPLA=ZPLAN(I,J)                                                         PICA1720
0159            IF(ZPLA-16.0)214,214,215                                                PICA1730
0160        215 ZPLA=16.0                                                               PICA1740
0161        214 CALL LAGINT(PSOZ(1),PSO(1),ZPLA,ZPSO,N4)                                PICA1750
0162         64 ZPS(I,J)=ZPSO                                                           PICA1760
0163         65 CONTINUE                                                                PICA1770
0164            DO 66 I=1,NLI                                                           PICA1780
0165            DO 67 J=1,NN                                                            PICA1790
0166            ANG2(I,J)=0.0                                                           PICA1800
0167         67 ANG1(I,J)=ATAN(SQRT(1.0-(HBAR/ZPLAN(I,J))**2)/(HBAR/ZPLAN(I,J)))*5      PICA1810
               17.2956                                                                  PICA1820
0168         66 CONTINUE                                                                PICA1830
0169            MM=1                                                                    PICA1840
0170            MMM=0                                                                   PICA1850
0171        102 DO 81 I=1,NLI                                                           PICA1860
0172            IF(MMM-2)205,206,205                                                    PICA1870
0173        206 ALPLAN(I)=ATAN(SQRT(1.0-(ZA/ZN(I))**2)/(ZA/ZN(I)))*57.2956              PICA1880
0174        205 DO 68 J=1,NN                                                            PICA1890
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      IF(MP-1)100,100,101                                          PICA1900
  101 IF(MMM-1)201,201,202                                         PICA1910
  201 ANG=ANG2(I,J)                                                PICA1920
      GO TO 182                                                    PICA1930
  202 ANG=ALPLAN(I)                                                PICA1940
      GO TO 182                                                    PICA1950
  100 ANG=ANG1(I,J)                                                PICA1960
  182 IF(ANG-40.9)82,83,83                                         PICA1970
   83 IF(ZPS(I,J)-22.1)84,85,85                                    PICA1980
   85 DO 86 LN=1,N2                                                PICA1990
      PAA(LN)=PA(18,LN)                                            PICA2000
   86 PPCR(LN)=PCR(18,LN)                                          PICA2010
      CALL LAG(PAA(1),PPCR(1),ANG,CRAL1,N2)                        PICA2020
      CRAL(I,J)=CRAL1                                              PICA2030
      GO TO 68                                                     PICA2040
   84 IF(ANG-52.5)87,85,85                                         PICA2050
   87 IF(ZPS(I,J)-9.8)88,89,89                                     PICA2060
   89 CRAL(I,J)=3.0                                                PICA2070
      GO TO 68                                                     PICA2080
   88 CRAL(I,J)=2.6                                                PICA2090
      GO TO 68                                                     PICA2100
   82 IF(ZPS(I,J)-3.7)69,70,71                                     PICA2110
   69 WRITE (6    ,927)
   70 K=1                                                          PICA2130
      GO TO 72                                                     PICA2140
   71 DO 73 L=2,17                                                 PICA2150
      IF(ZPS(I,J)-PCON(L))74,75,76                                 PICA2160
   74 MK=L                                                         PICA2170
      GO TO 77                                                     PICA2180
   75 K=L                                                          PICA2190
      GO TO 72                                                     PICA2200
   76 IF(ZPS(I,J)-7000.0)73,213,78                                 PICA2210
   73 CONTINUE                                                     PICA2220
   78 WRITE (6    ,914)
  213 K=17                                                         PICA2240
   72 DO 79 KK=1,N2                                                PICA2250
      PAA(KK)=PA(K,KK)                                             PICA2260
   79 PPCR(KK)=PCR(K,KK)                                           PICA2270
      CALL LAG(PAA(1),PPCR(1),ANG,CRAL1,N2)                        PICA2280
      CRAL(I,J)=CRAL1                                              PICA2290
      GO TO 68                                                     PICA2300
   77 DIFP=PCON(L)-ZPS(I,J)                                        PICA2310
      DO 80 KK=1,N2                                                PICA2320
      PPCR(KK)=PCR(MK,KK)-(PCR(MK,KK)-PCR(MK-1,KK))*DIFP/(PCON(MK)-PCONPICA2330
     1MK-1))                                                       PICA2340
   80 PAA(KK)=PA(MK,KK)                                            PICA2350
      CALL LAG(PAA(1),PPCR(1),ANG,CRAL1,N2)                        PICA2360
      CRAL(I,J)=CRAL1                                              PICA2370
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0222      88 CONTINUE                                                        PICA2380
0223      81 CONTINUE                                                        PICA2390
0224         MMM=MMM+1                                                       PICA2400
0225         IF(MM-1)103,103,104                                             PICA2410
0226     104 IF(MMM-2)103,203,207                                            PICA2420
0227     103 DO 91 I=1,NLI                                                   PICA2430
0228         DO 90 J=1,NN                                                    PICA2440
0229         PSPLAN(I,J)=CRAL(I,J)*ZPSI(I,J)                                 PICA2450
0230      90 ZPSI(I,J)=PSPLAN(I,J)                                           PICA2460
0231      91 CONTINUE                                                        PICA2470
0232         DO 92 I=1,NLI                                                   PICA2480
0233         DO 93 J=1,NN                                                    PICA2490
0234         B=J-1                                                           PICA2500
0235         DOPL(I,J)=SQRT(ZN(I)**2+(HBAR*B*SMB)**2)                        PICA2510
0236      93 ANG2(I,J)=ATAN(SQRT(1.0-(ZN(I)/DOPL(I,J))**2)/(ZN(I)/DOPL(I,J)))*5PICA2520
             17.2956                                                         PICA2530
0237      92 CONTINUE                                                        PICA2540
0238         MM=2                                                            PICA2550
0239         GO TO 102                                                       PICA2560
0240     203 DO 105 I=1,NLI                                                  PICA2570
0241         DO 106 J=1,NN                                                   PICA2580
0242         PRAL(I,J)=PSPLAN(I,J)*CRAL(I,J)                                 PICA2590
0243         PRA=PRAL(I,J)                                                   PICA2600
0244         CALL LAGINT(PR(1),PRZ(1),PRA,PRZZ,N5)                           PICA2610
0245         ZZ(I,J)=PRZZ                                                    PICA2620
0246         CALL LAGINT(PIRZ(1),PIR(1),PRZZ,PIRR,N6)                        PICA2630
0247     106 PIIR(I,J)=PIRR                                                  PICA2640
0248     105 CONTINUE                                                        PICA2650
0249         GO TO 102                                                       PICA2660
0250     207 DO 305 I=1,NLI                                                  PICA2670
0251         APRAL(I,1)=PSPLAN(I,1)*CRAL(I,1)                                PICA2680
0252         APRA=APRAL(I,1)                                                 PICA2690
0253         CALL LAGINT(PR(1),PRZ(1),APRA,APRZZ,N5)                         PICA2700
0254         AZZ(I,1)=APRZZ                                                  PICA2710
0255         CALL LAGINT(PIRZ(1),PIR(1),APRZZ,APIRR,N6)                      PICA2720
0256         APIIR(I,1)=APIRR                                                PICA2730
0257     305 CONTINUE                                                        PICA2740
0258         NSTOP=NN-1                                                      PICA2750
0259         DO 107 I=1,NLI                                                  PICA2760
0260         SUM(I)=PIIR(I,1)-PIIR(I,NN)                                     PICA2770
0261         DO 108 J=2,NSTOP,2                                              PICA2780
0262     108 SUM(I)=SUM(I)+PIIR(I,J)*4.0+PIIR(I,J+1)*2.0                     PICA2790
0263     107 SIMPAV(I)=SUM(I)/(3.0*SPH)                                      PICA2800
0264         DO 109 I=1,NLI                                                  PICA2810
0265         DO 110 J=1,NN                                                   PICA2820
0266         B=J-1                                                           PICA2830
0267         SV(J)=B*SMB                                                     PICA2840
0268     110 SPIIR(J)=PIIR(I,J)                                              PICA2850
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0269            SBAR=PHBAR(I)                                                    PICA2860
0270            CALL LAG(SV(I),SPII(RII),SBAR,SPINT,NN)                          PICA2870
0271            SPI(I)=SPINT                                                     PICA2880
0272            SIMPAV(I)=SIMPAV(I)+(APII(RI(,1)-FIIR(I,1)+APII(R(I,1)-SPII(I))*RHOAHPICA2890
               1(I)/2.0                                                          PICA2900
0273        109 CONTINUE                                                         PICA2910
0274            IF(NLTOL-1)120,121,121                                           PICA2920
0275        120 DO 114 I=1,NLI                                                   PICA2930
0276        114 FINAV(I)=SIMPAV(I)                                               PICA2940
0277            GO TO 115                                                        PICA2950
0278        121 N=NLTOL+1                                                        PICA2960
0279            DO 111 I=1,NLTOL                                                 PICA2970
0280            J=I+1                                                            PICA2980
0281            NK=N-I                                                           PICA2990
0282        111 FINAV(NK)=SIMPAV(J)                                              PICA3000
0283            DO 112 I=1,NLI                                                   PICA3010
0284            NK=NLTOL+I                                                       PICA3020
0285        112 FINAV(NK)=SIMPAV(I)                                              PICA3030
0286        115 NOVI=NLTOL+NLI                                                   PICA3040
0287            FISUM=FINAV(I)-FINAV(NOVI)                                       PICA3050
0288            NSTOP=NOVI-1                                                     PICA3060
0289            DO 113 I=2,NSTOP,2                                               PICA3070
0290        113 FISUM=FISUM+FINAV(I)*4.0+FINAV(I+1)*2.0                          PICA3080
0291            ANS(NC)=FISUM/(3.0*SPL)                                          PICA3090
0292            I=NC
0293            IF(ICODE(I).EQ.0)GO TO 936
0294            ANS(I)=ANS(I)*6**.333333
0295            GO TO(928,929,930,931),I
0296        928 WRITE(6,932)ANS(I)
0297        932 FORMAT(10X,5HFLOOR,40X,F10.2/)
0298            GO TO 927
0299        929 WRITE(6,933)ANS(I)
0300        933 FORMAT(10X,5HROOF ,40X,F10.2/)
0301            GO TO 927
0302        930 WRITE(6,937)ANS(I)
0303        937 FORMAT(10X,14HLEFT SIDE WALL,31X,F10.2/)
0304            GO TO 927
0305        931 WRITE(6,934)ANS(I)
0306        934 FORMAT(10X,15HRIGHT SIDE WALL,30X,F10.2/)
0307        927 CONTINUE
0308            TOTAL=TOTAL+ANS(NC)                                              PICA3100
0309        936 CONTINUE
0310            IF(NC.EQ.4)WRITE(6,939)TOTAL
0311        939 FORMAT(50X,5HTOTAL,F10.2)
0312          8 IF(NWALL-NC)1,1,116                                              PICA3130
0313        116 NC=NC+1                                                          PICA3140
0314            GO TO (10,11,12,11),NC
0315         11 HLIT=H-HLIT
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      GO TO 10
   12 SAVE=H
      HLIT=H-HLIT
      H=FL
      EL=SAVE
      SAVE=HLIT
      HLIT=ELLIT                                                        PICA3150
      ELLIT=SAVE                                                        PICA3160
   10 CONTINUE                                                          PICA3170
      GO TO 2                                                           PICA3180
  801 FORMAT(4H ZA=,F10.3)                                              PICA3220
  602 FORMAT(1H1)                                                       PICA3230
  803 FORMAT(2I5,2F10.3)                                                PICA3240
  902 FORMAT(4F10.3,4I5,A4,A4,A2)                                       PICA3250
  903 FORMAT(I5/(6F10.3))                                               PICA3260
  904 FORMAT(2I5)                                                       PICA3270
  905 FORMAT(47H HBAR(I) SMALLER THAN 0.0625 OR BIGGER THAN 5.0)        PICA3280
  906 FORMAT(7F10.3)                                                    PICA3290
  907 FORMAT(43H PSO SMALLER THAN 3.7, USED PSO=3.7          )          PICA3300
  908 FORMAT(29H AVERAGE REFLECTED IMPULSE OF, I5,11H WALL(S) IS,F10.2) PICA3310
  909 FORMAT(25H HEIGHTS OF MACH STEM ARE, 4F10.5/(7F10.5))             PICA3320
  910 FORMAT(29H AVERAGE REFLECTED IMPULSE IS, F10.2)                   PICA3330
  911 FORMAT(7H ZB/ZA=,F10.3,6X,7H L/L   =,F10.3,6X,7H H/H   =,F10.3,/
     17H L/H   =,F10.3,6X,7H NSPL =,I10,6X,7H NSPH =,I10,/
     27H NLT   =,I10,6X,7H NLTOL=,I10)
  912 FORMAT(41H HBAR LESS THAN 0.0625, SKIP TO NEXT CASE)              PICA3350
  913 FORMAT(A4,A4,A2)                                                  PICA3360
  914 FORMAT(43H PSO BIGGER THAN 7000.0, USED PSO=7000.0     )          PICA3370
  915 FORMAT(7F10.6)                                                    PICA3380
  916 FORMAT(41H HBAR LARGER THAN 15.0, SKIP TO NEXT CASE)
      END
```

```
      SUBROUTINE HBA(HBAR,PZ,PH,ZN,PHBAR1,N1,NL1,HCON)
      DIMENSION PZZ(16),PHH(16),PZ(16,16),PH(16,16),HCON(12)
      IF(HBAR-0.0625)5,6,7
    5 WRITE (6,905)
      RETURN
    6 K=1
      GO TO 8
    7 IF(HBAR-0.125)9,10,11
    9 MK=1
      GO TO 12
   10 K=2
      GO TO 8
   11 IF(HBAR-0.25)13,14,15
   13 MK=2
      GO TO 12
   14 K=3
      GO TO 8
   15 IF(HBAR-0.375)16,17,18
   16 MK=3
      GO TO 12
   17 K=4
      GO TO 8
   18 IF(HBAR-0.5)19,20,21
   19 MK=4
      GO TO 12
   20 K=5
      GO TO 8
   21 IF(HBAR-0.75)22,23,24
   22 MK=5
      GO TO 12
   23 K=6
      GO TO 8
   24 IF(HBAR-1.0)25,26,27
   25 MK=6
      GO TO 12
   26 K=7
      GO TO 8
   27 IF(HBAR-1.5)28,29,30
   28 MK=7
      GO TO 12
   29 K=8
      GO TO 8
   30 IF(HBAR-2.0)31,32,33
   31 MK=8
      GO TO 12
   32 K=9
      GO TO 8
   33 IF(HBAR-3.0)34,35,36
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   34 MK=9
      GO TO 12
   35 K=10
      GO TO 9.
   36 IF(HBAR-4.0)37,38,39
   37 MK=10
      GO TO 12
   38 K=11
      GO TO 8
   39 IF(HBAR-5.0)40,41,41
   40 MK=11
      GO TO 12
   41 K=12
    8 DO 42 L=1,N1
      PZZ(L)=PZ(K,L)
   42 PHH(L)=PH(K,L)
      CALL LAGINT(PZZ(1),PHH(1),ZN,PHBAR1,N1)
      RETURN
   12 DIFH=HBAR-HCON(MK)
      DO 44 L=1,N1
      PZZ(L)=PZ(MK,L)+(PZ(MK+1,L)-PZ(MK,L))*DIFH/(HCON(MK+1)-HCON(MK))
   44 PHH(L)=PH(MK,L)
      CALL LAGINT(PZZ(1),PHH(1),ZN,PHBAR1,N1)
      RETURN
  905 FORMAT(47H HBAR(1) SMALLER THAN 0.0625 OR BIGGER THAN 5.0)
  906 FORMAT(36H HBAR BIGGER THAN 5.0, USED HBAR=5.0)
      END
```

```
FORTRAN IV G LEVEL 1, MOD 2          LAGINT          DATE = 69342          15/42/41          PAGE 0001

                 SUBROUTINE LAGINT(XLOG,FLOG,XOLOG,FO,N)
                 DIMENSION X(16),P(16),F(16),XLOG(16),FLOG(16)
                 DO 1030 M=1,N
                 X(M)=ALOG(XLOG(M))
                 F(M)=ALOG(FLOG(M))
            1030 CONTINUE
                 XO=ALOG(XOLOG)
                 DO 1010 M1=1,N
                 P(M1)=1
                 DO 1010 M=1,N
                 IF(M-M1)1009,1010,1009
            1009 P(M1)=P(M1)*(XO-X(M))/(X(M1)-X(M))
            1010 CONTINUE
                 FO=0.0
                 DO 1020 M=1,N
            1020 FO=FO+P(M)*F(M)
                 IF(FO-88.)100,100,101
             101 FO=88.
             100 FO=2.7182**FO
                 RETURN
                 END
```

```
0001                SUBROUTINE LAG(X,F,XO,FO,N)                              0010
0002                DIMENSION X(30),P(30),F(30)                              0020
0003                DO 1010 M=1,N                                            0040
0004                P(M)=1                                                   0050
0005                DO 1010 M1=1,N                                           0060
0006                IF(M1-M)1009,1010,1009                                   0070
0007          1009  P(M)=P(M)*(XO-X(M1))/(X(M)-X(M1))                        0080
0008          1010  CONTINUE                                                 0090
0009                FO=0.0                                                   0100
0010                DO 1020 M1=1,N                                           0110
0011          1020  FO=FO+P(M1)*F(M1)                                        0120
0012                RETURN
0013                END
```

```
      SUBROUTINE RATIO(R,EL,ELLIT,H,HLIT,ZBZA,RLL,HH,RLH)
      ZBZA=.5*(EL/R)
      RLL=ELLIT/EL
      HH=HLIT/H
      RLH=EL/H
      IF(RLL.LT.0.1)RLL=0.1
      IF(RLL.GT.0.75)RLL=0.75
      IF(HH.LT.0.15)HH=0.15
      IF(HH.GT.0.75)HH=0.75
      IF(RLH.GT.6.)RLH=6.
      IF(RLH.GT.6.)ZBZA=0.5*(6.*H/R)
      RETURN
      END
```

```
FORTRAN IV G LEVEL 1, MOD 2          GRID          DATE = 69342          15/42/41          PAGE 0001

      SUBROUTINE GRID(A,ALIT,NA,L)
C     DETERMINES NUMBER OF VERTICAL AND HORIZONTAL LINES FOR GRID
      DIMENSION XX(50)
      Z=AMIN1(ALIT,A-ALIT)
      DO 21 I=2,20,2
      SAVE=1.E+5
      NA=I
      K=I
      SPWTH=A/K
      DO 30 J=1,I
      WJ=J
      X=WJ*SPWTH
      XX(J)=ABS(Z-X)
      K=J
      ANS=AMIN1(XX(J),SAVE)
      SAVE=ANS
      IF(XX(J)-0.2)20,20,31
   31 XXX=ABS(SAVE-XX(J))
      IF(SAVE-XXX)21,30,30
   30 CONTINUE
   21 CONTINUE
   20 CONTINUE
      IF(NA.NE.20)GO TO 23
      DO 22 I=1,K
      L=I
      IF(ANS-XX(I))22,23,22
   22 CONTINUE
   23 CONTINUE
      IF(NA.NE.20)L=K
      RETURN
      END
```

REQUIRED INPUT DATA

FORMAT (I5/(6F10.8))

CARD NUMBER						
2	12					
3	0.35	0.012	0.405	0.03	0.49	0.07
4	0.55	0.1	0.730	0.2	0.93	0.40
5	1.07	0.5	1.19	0.7	1.30	1.0
6	1.37	1.30	[illegible]	1.6	1.45	2.0
7	0.435	0.012	0.50	0.03	0.62	0.07
8	0.705	0.1	0.955	0.2	1.24	0.40
9	1.33	0.5	1.49	0.7	1.65	1.0
10	1.77	1.30	1.84	1.6	1.90	2.0
11	0.6	0.012	0.655	0.03	0.8	0.07
12	0.9	0.1	1.2	0.2	1.59	0.40
13	1.7	0.5	1.88	0.7	2.1	1.0
14	2.25	1.30	2.36	1.6	2.5	2.0
15	0.69	0.012	0.74	0.03	0.95	0.07
16	1.09	0.1	1.43	0.2	1.89	0.40
17	2.04	0.5	2.3	0.7	2.6	1.0
18	2.76	1.30	2.95	1.6	3.1	2.0
19	0.77	0.012	0.9	0.03	1.11	0.07
20	1.26	0.1	1.63	0.2	2.14	0.40
21	2.33	0.5	2.67	0.7	[illegible]	1.0
22	3.25	1.30	3.50	1.6	3.7	2.0
23	[illegible]	0.012	[illegible]	0.03	1.4	0.07
24	[illegible]	0.1	2.1	0.2	2.9	0.40
25	3.1	0.5	3.55	0.7	4.1	1.0
26	4.3	1.30	4.6	1.6	4.9	2.0
27	1.1	0.012	1.25	0.03	1.65	0.07
28	1.9	0.1	2.55	0.2	3.4	0.40
29	3.7	0.5	4.15	0.7	4.75	1.0
30	5.1	1.30	5.55	1.6	6.0	2.0
31	1.48	0.012	1.7	0.03	2.25	0.07
32	2.60	0.1	3.45	0.2	4.6	0.40
33	5.0	0.5	5.7	0.7	6.4	1.0
34	7.0	1.30	7.5	1.6	8.0	2.0
35	1.7	0.012	2.02	0.03	2.6	0.07
36	2.95	0.1	4.0	0.2	5.3	0.40
37	5.95	0.5	6.75	0.7	7.8	1.0
38	8.6	1.30	9.3	1.6	9.8	2.0
39	2.7	0.012	3.15	0.03	4.0	0.07
40	4.6	0.1	6.0	0.2	7.7	0.40
41	8.3	0.5	9.4	0.7	10.7	1.0
42	11.7	1.30	13.0	1.6	13.4	2.0
43	5.1	0.012	5.7	0.03	6.6	0.07
44	7.1	0.1	9.3	0.2	12.1	0.40
45	10.8	0.5	12.1	0.7	13.6	1.0
46	15.0	1.30	16.0	1.6	17.2	2.0
47	7.3	0.012	7.8	0.03	9.0	0.07
48	9.45	0.1	10.7	0.2	12.4	0.40
49	11.2	0.5	14.45	0.7	16.0	1.0
50	17.25	1.30	18.5	1.6	20.1	2.0
51	4					
52	0.	2.2	15.	2.1	30.	2.1
53	40.	2.2	0.	2.48	15.	2.48
54	30.	2.48	40.	2.68	0.	3.1
55	15.	3.06	30.	2.93	40.	3.45
56	0.	4.16	15.	4.14	30.	3.72
57	40.	4.4	0.	5.36	35.	5.2
58	30.	4.77	40.	5.1	0.	6.15

E

CARD NUMBER						
59	15.	5.9	30.	5.6	40.	5.45
60	0.	6.7	15.	6.46	30.	6.18
61	40.	6.0	0.	7.24	15.	7.0
62	30.	6.7	40.	6.56	0.	7.6
63	15.	7.3	30.	7.0	40.	6.96
64	0.	[illegible]	15.	7.7	30.	7.45
65	40.	7.28	0.	8.4	15.	9.1
66	30.	7.85	40.	7.66	0.	8.74
67	15.	8.46	30.	8.18	40.	8.0
68	0.	9.0	15.	8.7	30.	8.43
69	40.	8.25	0.	9.6	15.	9.3
70	30.	9.07	40.	8.96	0.	10.3
71	15.	10.0	30.	9.75	40.	9.56
72	0.	11.	15.	10.7	30.	10.43
73	40.	10.25	0.	11.37	15.	11.68
74	30.	11.4	40.	11.2	40.5	3.65
75	55.	2.85	70.	2.05	90.	1.0
76	16					
77	0.136	6900.	0.177	5580.	0.252	4640.
78	0.379	3240.	0.505	2340.	0.757	1320.
79	1.262	575.	1.770	322.	2.525	162.
80	3.780	55.	5.05	25.8	7.57	10.9
81	12.52	4.1	17.70	2.6	25.25	1.7
82	50.5	0.71				
83	16					
84	0.136	82500.	0.177	67600.	0.252	50000.
85	0.379	31500.	0.505	21450.	0.757	11420.
86	1.262	4650.	1.770	2240.	2.525	925.
87	3.780	240.	5.05	87.5	7.57	28.2
88	12.62	9.4	17.70	5.7	25.25	3.5
89	50.5	1.44				
90	16					
91	0.136	4350.	0.177	3620.	0.252	2600.
92	0.379	1595.	0.505	1080.	0.757	550.
93	1.262	244.	1.770	150.	2.525	90.
94	3.780	51.	5.05	34.	7.57	20.
95	12.62	10.8	17.70	7.5	25.25	5.2
96	50.5	2.7				

**** E N D O F D A T A ****

/*

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13. ABSTRACT

An improved computer program was formulated to calculate the average blast impulse loads acting on a wall of a cubicle when an explosive charge is detonated within the cubicle. It was devised by the Ammunition Engineering Directorate's Process Engineering Laboratory in connection with the Safety Design Criteria Program and it simplifies an earlier computer program used to calculate data points for the construction of impulse charts in Technical Manual 5-1300, "Structures to Prevent the Effects of Accidental Explosion."

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Improved Computer Program Fortran IV Average blast impulse load Cubicle wall Technical Manual 5-1300 Impulse charts Step-by-step procedure						

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